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**Yeo et al.**

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(54) **METHODS AND APPARATUSES FOR PROVIDING GUIDE INFORMATION FOR A CAMERA**

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**G09G 3/34** (2006.01)

(52) **U.S. Cl.**

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(2013.01); **G09G 3/3406** (2013.01); **H04N**  
**5/23293** (2013.01)

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3/3406

USPC ..... 348/234, 370  
See application file for complete search history.

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

6,806,906 B1 \* 10/2004 Soga ..... H04N 5/232

348/333.03

2009/0115868 A1 \* 5/2009 Kim ..... H04N 5/232

348/222.1

2010/0074613 A1 3/2010 Masuno et al.

2012/0320262 A1 \* 12/2012 Chung ..... H05B 37/0272  
348/370

**FOREIGN PATENT DOCUMENTS**

JP 2009-212802 A 9/2009

\* cited by examiner

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(57) **ABSTRACT**

The present invention relates to methods and apparatuses for providing guide information for a camera. An image is collected through the camera. The image includes a subject illuminated by a light source. An optimized direction is determined for the light source relative to the subject. Guide information is generated that specifies an adjustment of the light source relative to the subject for achieving the optimized direction for the light source. The generated guide information is outputted to provide a visual, audible, or tactile indication.

**22 Claims, 13 Drawing Sheets**

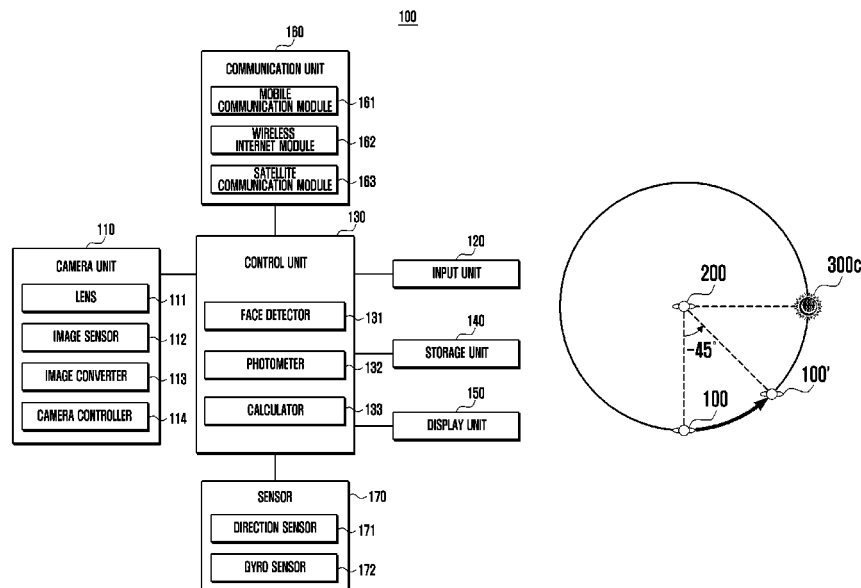


FIG. 1

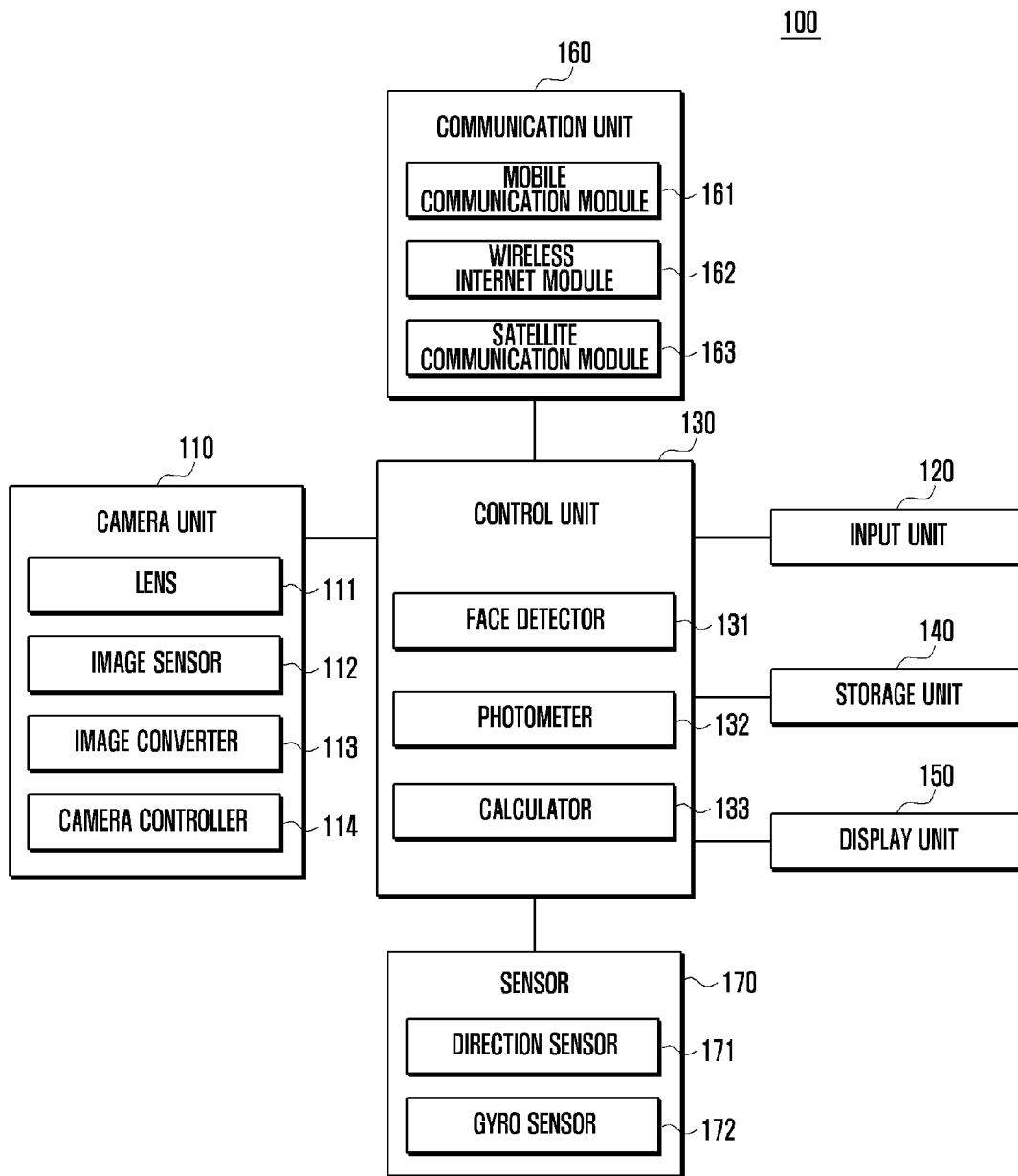


FIG. 2

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11 GUIDE PROVIDING MODE ☐ ON ☐ OFF

12 SET DIRECTION OF LIGHT SOURCE

PURITY LIGHT	<input type="checkbox"/>
PLAIN LIGHT	<input checked="" type="checkbox"/>
SIDE LIGHT	<input type="checkbox"/>
CROSS LIGHT	<input type="checkbox"/>
BACK LIGHT	<input type="checkbox"/>

13 AUTOMATIC CONTROL FOR PHOTOGRAPHING MODE ☐ ON ☐ OFF

FIG. 3

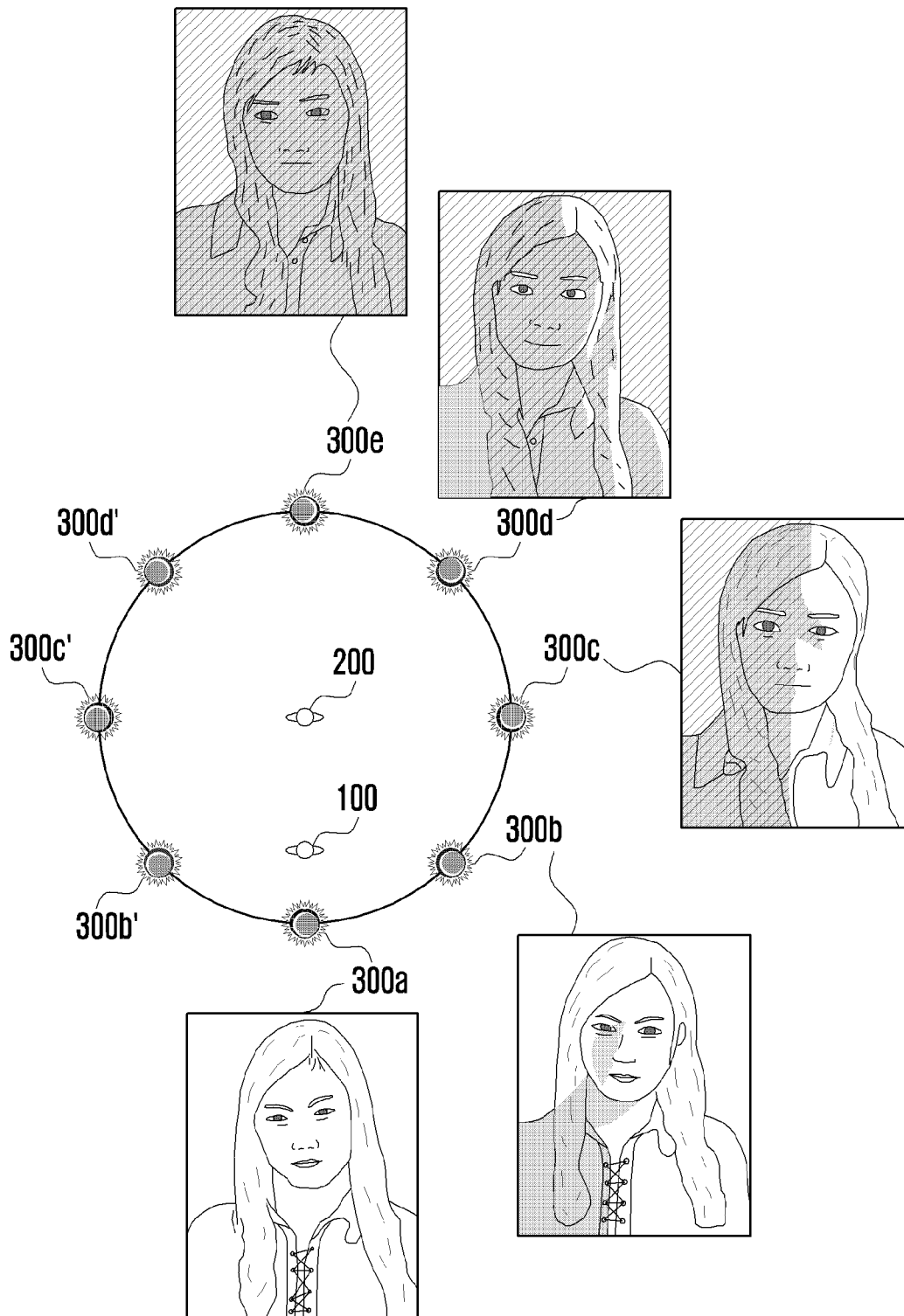


FIG. 4

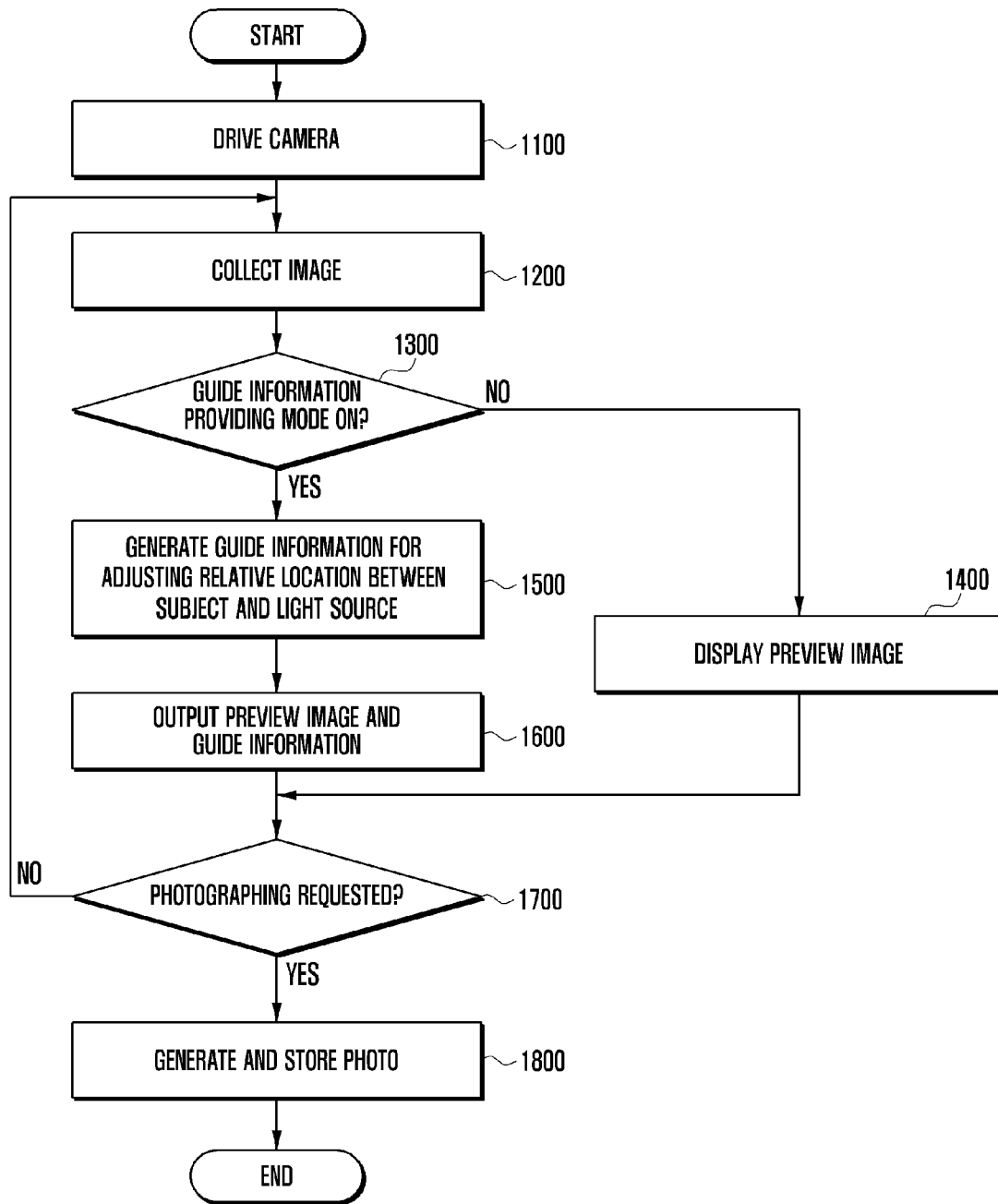


FIG. 5



FIG. 6

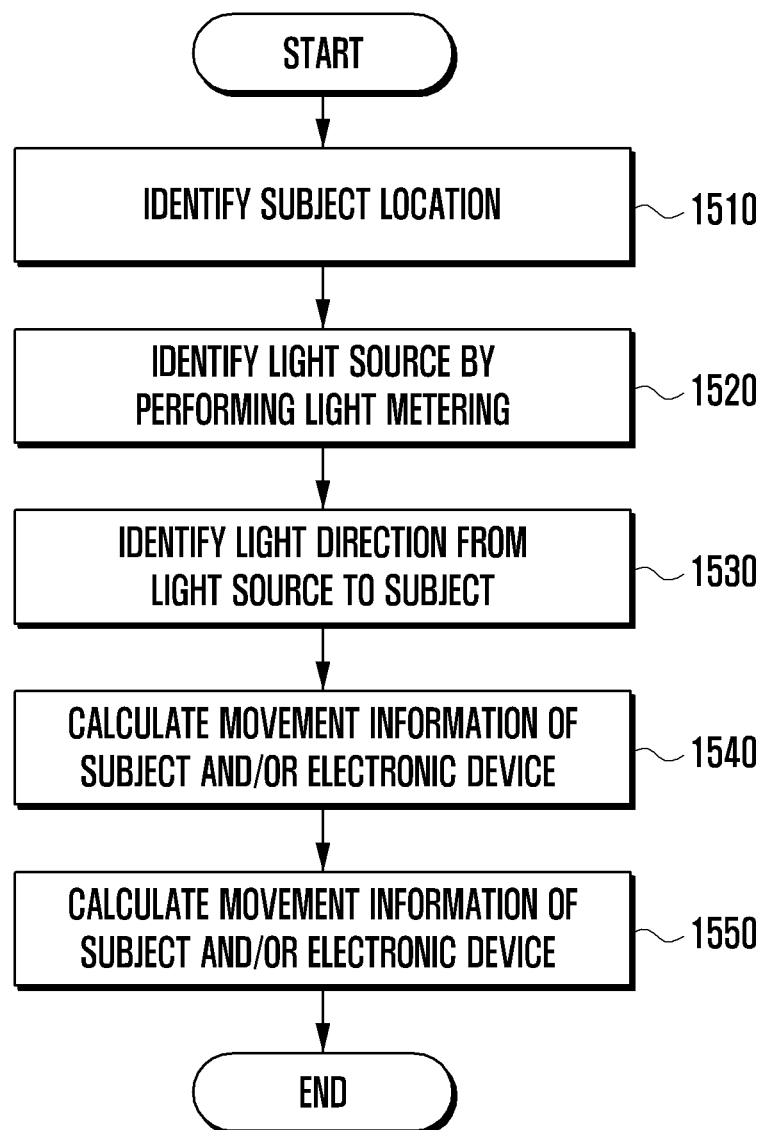


FIG. 7

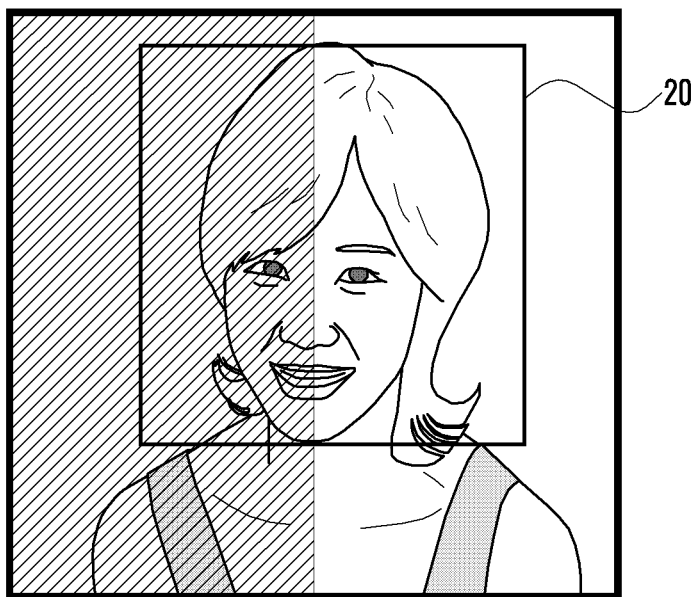




FIG. 8

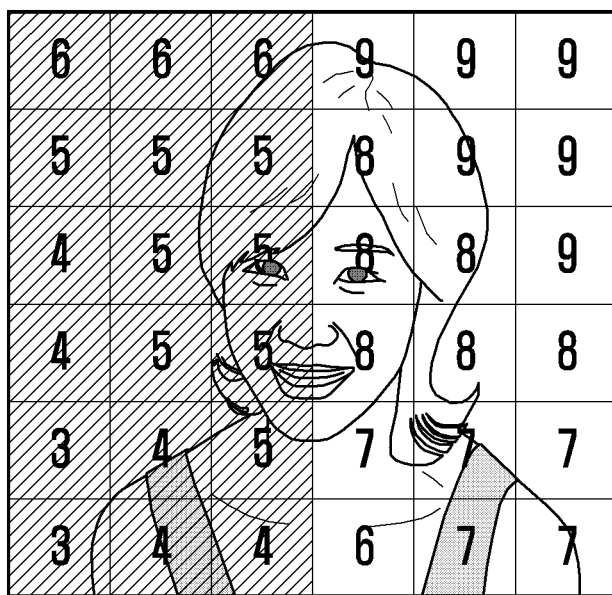


FIG. 9

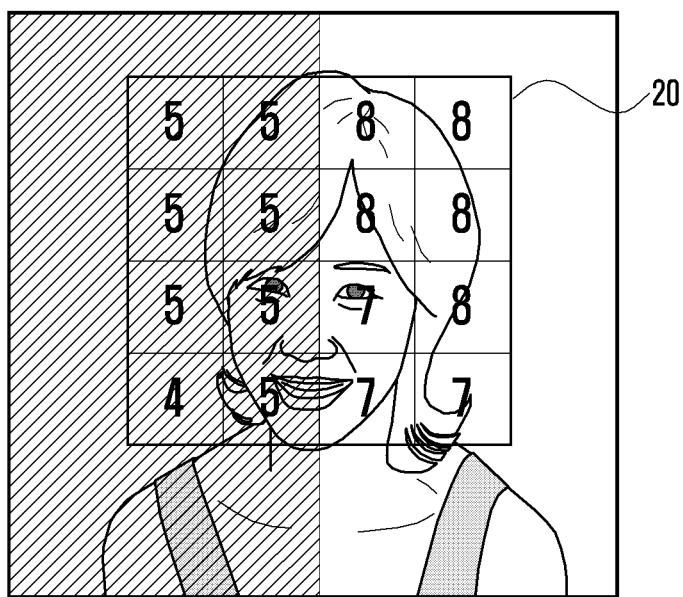


FIG. 10

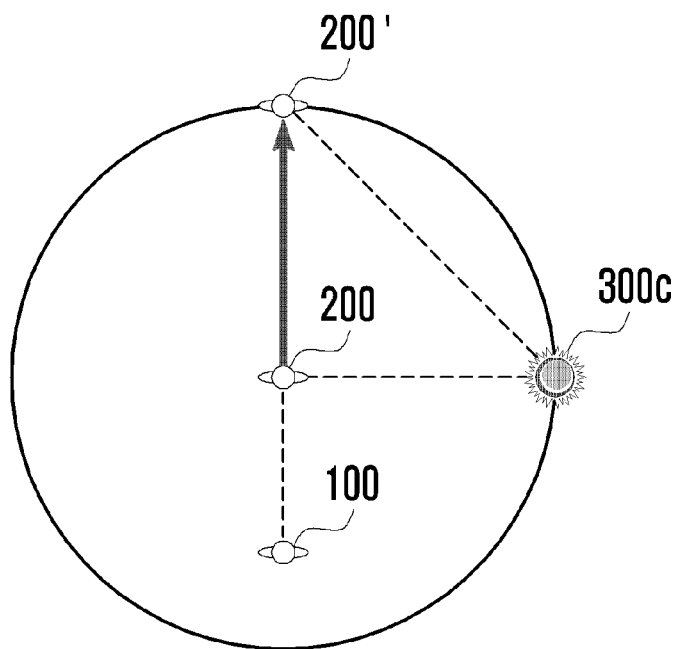


FIG. 11

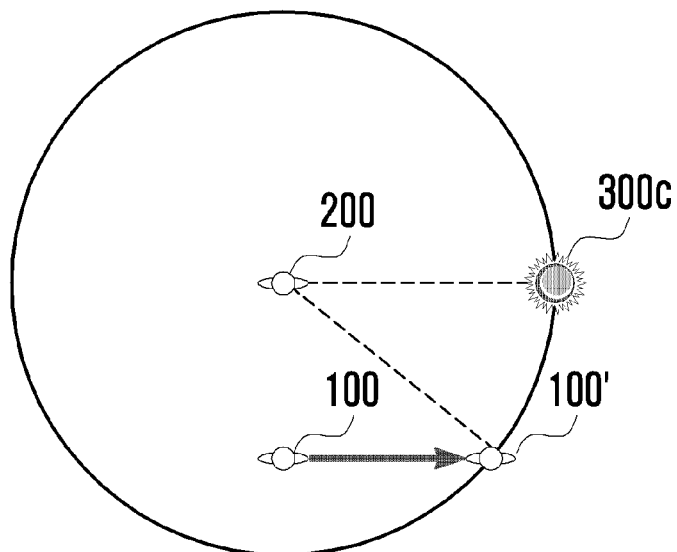


FIG. 12

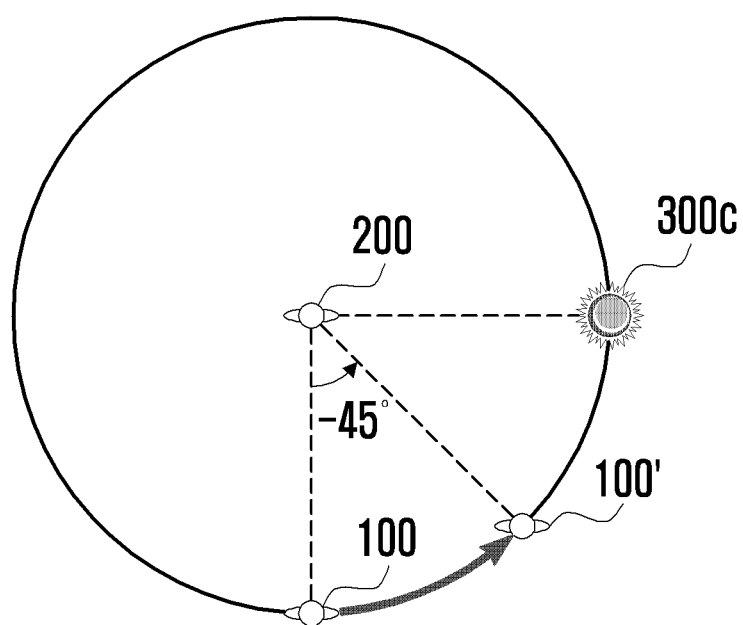


FIG. 13

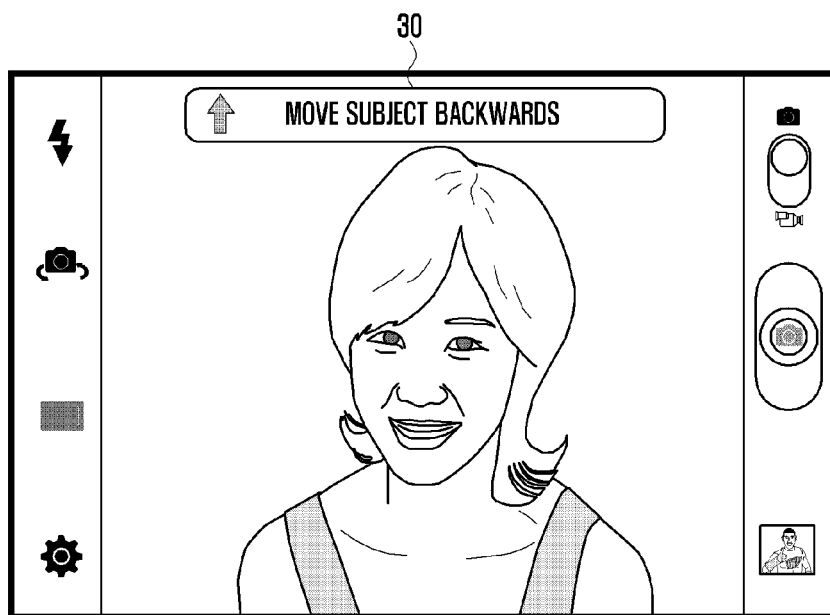
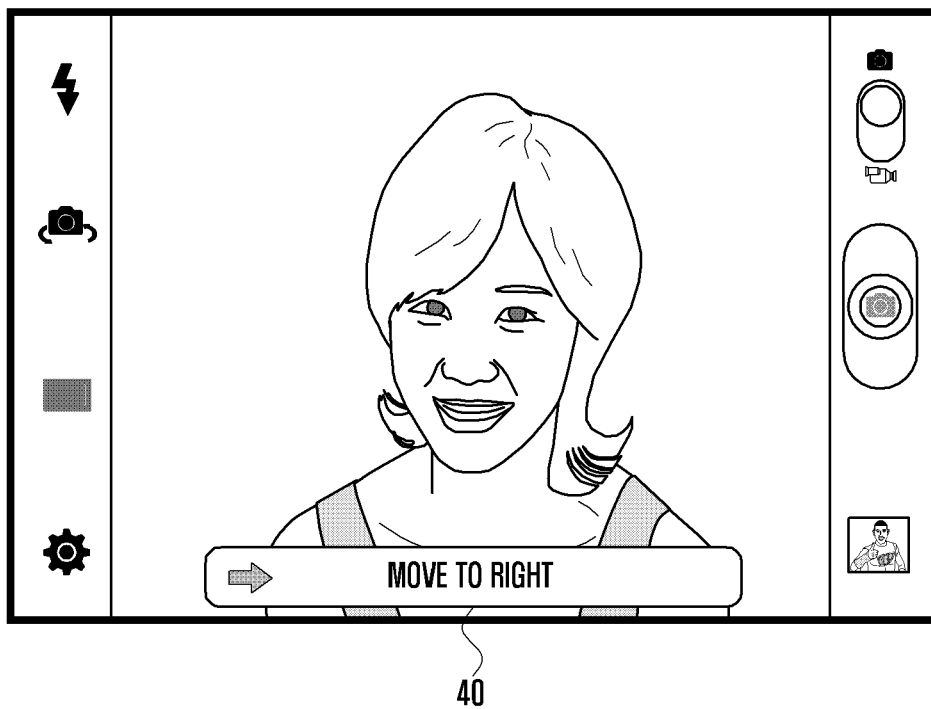


FIG. 14



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# METHODS AND APPARATUSES FOR PROVIDING GUIDE INFORMATION FOR A CAMERA

## CLAIM OF PRIORITY

This application claims priority under 35 U.S.C. §119(a) to Korean Patent Application Serial No. 10-2013-0038706 filed in the Korean Intellectual Property Office on Apr. 9, 2013, the entire disclosure of which is incorporated by reference herein.

## BACKGROUND

### 1. Technical Field

The present disclosure relates to methods and apparatuses for providing guide information for a camera and, more particularly, to methods and apparatuses for providing guide information for adjusting a direction of a light source that illuminates a subject to achieve an optimum orientation of the light source relative to the subject.

### 2. Description of the Related Art

At present, conventional cameras provide a function for adjusting the brightness of an image to obtain a desired result. There are two methods for adjusting the brightness of an image provided by the camera. The first method uses an internal strobe or a detachable strobe as an auxiliary light source. The strobe provides a predetermined amount of light at the moment of photographing by synchronizing with a camera control system. The second method selects a desired or correct lighting condition by controlling a shutter speed, an aperture setting, auto white balance (AWB), and a numerical exposure index adopted by the International Standardization Organization (ISO) that may be used to indicate the light sensitivity of the camera.

However, a strobe provides a limited amount of light, and therefore cannot be used to obtain an adequate photo under conditions of low ambient light. Moreover, a strobe provides a different level of image quality compared to a photo taken with a natural light source. The foregoing method of controlling a photographing mode of the camera permits adjustments only within the range of ambient light provided by a given photographing environment, and thereby the usability of this method is limited.

Basically, controlling the brightness of an image or controlling an exposure in photographing is preferable to processing the image after the image has been gathered.

## SUMMARY

In accordance with an aspect of the present disclosure, a method provides guide information for a camera that specifies an adjustment of a location of a subject relative to a light source that is illuminating the subject.

In accordance with another aspect of the present disclosure, a method provides guide information for a camera. The method comprises collecting an image through the camera, wherein the image includes a subject illuminated by a light source; determining an optimized direction for the light source relative to the subject; generating guide information that specifies an adjustment of the light source relative to the subject for achieving the optimized direction for the light source; and outputting the generated guide information.

In accordance with another aspect of the present disclosure, a method provides guide information for a camera by extracting an area of a subject from an image and determin-

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ing a location of a light source by using a photometric method, to permit adjustment of the subject relative to the camera.

In accordance with another aspect of the present disclosure, a method provides guide information for a camera in an electronic device that includes a camera unit, the method comprising: collecting a preview image using the camera unit, generating guide information that specifies an adjustment of a direction of a light source for a subject in the preview image according to a predetermined direction of the light source, and outputting the generated guide information.

The generating of guide information includes: measuring a direction of the light source for the subject in the image, and calculating movement information for at least one of the subject or the electronic device based on a difference between the predetermined direction of the light source and a measured direction of the light source.

The measuring of the direction of the light source includes: identifying a location of the subject in the image, identifying a location of the light source by performing light measuring within the image; and identifying the direction of the light source based on the location of the subject in the image and the location of the light source.

The identifying of the location of the subject includes: detecting a user's input for the image, wherein the image includes a plurality of subjects, and identifying a location of a specific subject from the plurality of subjects in response to the user's input.

The identifying of the location of the subject includes extracting a face area of the subject by using a face detecting algorithm.

The identifying of the location of the light source includes: dividing the image into a plurality of areas, measuring an exposure value for each of the plurality of areas, and identifying a location of the light source based on a comparison of the measured exposure value for each of the plurality of areas.

The identifying of the location of the light source includes: dividing the image into a plurality of areas, measuring an exposure value for each of the plurality of areas divided from the image, dividing a face area of the image into a plurality of sub-areas of the face area, measuring an exposure value for each of the plurality of sub-areas divided from the face area, and identifying a location of the light source based on the exposure value for each of the plurality of areas of the image and the exposure value for each of the plurality of sub-areas of the face area.

The generating guide information comprises: identifying an angle difference between an actual direction of the light source and a predetermined direction of the light source, identifying a distance between the camera unit and the subject, calculating a curved movement distance based on the angle difference and the distance between the camera unit and the subject according to the following Formula 1, and generating the guide information by using at least one of the angle difference or the curved movement distance.

$$l=r\times\theta$$

Formula 1

where  $l$  is a curved movement distance,  $r$  is a distance between a camera unit and a subject, and  $\theta$  is an angle difference in radians.

The outputting guide information includes displaying both a preview image of the image and the guide information.

The outputting guide information comprises outputting at least one of a voice, a vibration, a solid light, a flashing light, or a visual graphical indication corresponding to the guide information.

The direction of the light source may be any of front light, plain light, side light, cross light, diffuse light, or back light.

In accordance with another aspect of the present disclosure, an electronic device includes a camera unit for collecting an image of at least one subject, a control unit for generating guide information to adjust a direction of a light source relative to a subject in the image collected through the camera unit according to a predetermined direction of the light source, and a display unit for displaying the guide information generated by the control unit.

The control unit measures a direction of the light source that is illuminating the subject in the image, calculates movement information for at least one of the subject or the electronic device based on the difference between the predetermined direction of the light source and the measured direction of the light source, and generates the guide information based on the movement information.

The control unit identifies a location of the subject in the image, identifies a location of the light source by performing light intensity measuring within each of a plurality of portions of the image, and identifies a direction of the light source based on the location of the subject and the location of the light source.

The electronic device further includes an input unit for receiving a user's input, wherein the control unit identifies a location of a specific subject from a plurality of subjects in response to detecting the user's input at the input unit.

The control unit extracts a face area of the subject by using a face detecting algorithm.

The control unit divides the image into a plurality of areas, measures an exposure value for each of the plurality of areas, and identifies a location of the light source based on the measured exposure value for each of the plurality of areas.

The control unit divides the image into a plurality of areas, measures an exposure value for each of the plurality of areas divided from the image, divides a face area of the image into a plurality of sub-areas of the face area, measures an exposure value for each of the plurality of sub-areas divided from the face area, and identifies a location of the light source based on the exposure value for each of the plurality of areas of the image and the exposure value for each of the plurality of sub-areas of the face area.

The display unit displays both a preview image of the image and the guide information under the control of the control unit.

The direction of the light source may be any of front light, plain light, side light, cross light, diffuse light, and back light.

The method of providing guide information for a camera optimizes an image, not by using artificial auxiliary lighting or a pre-specified photographing environment, but rather by providing guide information so that the locations of one or more of a light source, a subject, and a user using the electronic device may be actively changed. Therefore, an optimized photographic image can be obtained by using this method.

Further, the method of providing guide information for a camera enables an unskilled user of photometric technology to easily take an optimized photo, and also provides a user with a learning tool that shows the user how to arrange a light source and a subject to obtain an optimized photographic image.

## BRIEF DESCRIPTION OF THE DRAWINGS

The features and advantages of the present invention will be more apparent from the following detailed description in conjunction with the accompanying drawings, in which:

FIG. 1 is a block diagram showing an illustrative configuration of an electronic device constructed in accordance with an exemplary embodiment of the present invention;

FIG. 2 is a drawing showing an illustrative setting screen that provides guide information to a camera according to an exemplary embodiment of the present invention;

FIG. 3 is a drawing that illustrates determination of a direction of a light source;

FIG. 4 is a flow chart showing an illustrative method of providing guide information to a camera according to an exemplary embodiment of the present invention;

FIG. 5 is a drawing showing an exemplary image collected or gathered by a camera unit;

FIG. 6 is a flow chart showing an illustrative method of generating guide information according to an exemplary embodiment of the present invention;

FIG. 7 is a drawing showing an example of extracting a face area of a subject from an image;

FIG. 8 is a drawing showing an example of performing a light measuring procedure;

FIG. 9 is a drawing showing an example of performing a light measuring procedure for a face area of a subject;

FIG. 10 is a drawing showing an example of moving a subject in response to generated guide information according to an exemplary embodiment of the present invention;

FIG. 11 is a drawing showing an example of moving an electronic device in response to generated guide information according to an exemplary embodiment of the present invention;

FIG. 12 is a drawing showing an example of moving an electronic device along a circular path in response to generated guide information according to an exemplary embodiment of the present invention;

FIG. 13 is a drawing showing an example of displaying guide information; and

FIG. 14 is a drawing showing another example of displaying guide information.

## DETAILED DESCRIPTION

The present invention may be applied to provide guide information for an electronic device having a camera.

Further, the present invention may be applied not only to an electronic device having a camera such as a digital camera, smart camera, smart phone, portable terminal, mobile terminal, PDA (Personal Digital Assistant), PMP (Portable Multimedia Player), notepad, Wibro terminal, tablet PC, Notebook, and computer, but also to any equipment that is installable with, or capable of interfacing with, a camera.

Hereinafter, exemplary embodiments of the present invention are described in detail with reference to the accompanying drawings. The same reference symbols are used throughout the drawings to refer to the same or like parts. Detailed descriptions of well-known functions and structures incorporated herein may be omitted to avoid obscuring the subject matter of the present invention.

In the description of the present invention, a singular form may encompass plural forms as well. Further, the terms "comprise" and "include" should not be understood to include all the components or all the steps listed in the description. Hereinafter, exemplary embodiments of the



present invention are described in more detail with reference to the accompanying drawings.

FIG. 1 is a block diagram showing an illustrative configuration of an electronic device **100** constructed according to an exemplary embodiment of the present invention.

The electronic device **100** includes a camera unit **110**, an input unit **120**, a control unit **130**, a storage unit **140**, a display unit **150**, a communication unit **160**, and a sensor **170**.

The camera unit **110** collects an image of at least one subject. The camera unit **110** includes a lens **111**, an image sensor **112** for converting a light signal projected to the lens **111** to an electric signal, an image converter **113** for processing the signal output by the image sensor **112** and for converting the signal to a digital signal in a suitable format to be processed by the control unit **130**, and a camera controller **114** for controlling the general operation of the camera unit **110**.

The lens **111** is configured with at least one lens, and collects an image by collecting or gathering light and transmitting the collected or gathered light to the image sensor **112** under the control of the camera controller **114**. The image sensor **112** may be configured with a CMOS image sensor device or a CCD image sensor device, and converts the image to an electronic signal by outputting an electric current or voltage that is proportional to, or a function of, the brightness of the collected image. The image sensor **112** generates a signal for each pixel of the image, and may sequentially output the signals by synchronizing with a clock. The image converter **113** may convert the signal output by the image sensor **112** to digital data. The image converter **113** may compress the converted digital data to a JPEG format, or include a codec for compressing the digital data to an MPEG format. The digital data converted by the image converter **113** may be transmitted to the control unit **130** under the control of the camera controller **114**, and may be used for the operation of the electronic device **100**.

For example, the control unit **130** may control the display unit **150** to display an image collected by the camera unit **110** as a preview image so that a user can identify the image projected through the camera. Further, according to a request for photographing accepted from the user, the control unit **130** may generate a photo image by using the image collected by the camera unit **110** at the time of photographing. The generated photo image may be stored in the storage unit **140** temporarily or permanently.

The camera unit **110** may be configured with more than one camera. For example, the camera unit **110** may be configured with a first camera (or front camera) for a self-photographing mode and a second camera (or rear camera) for photographing a subject located in front of the user. The camera unit **110** may generate signals for the collected image and signals including information for identifying whether the image is collected from the first camera or the second camera, and transmit these signals to the control unit **130**.

The input unit **120** detects a user's input, and transmits an input signal corresponding to the user's input to the control unit **130**. The input unit **120** may include any of a keypad, a dome switch, a touchpad (resistive or capacitive), a jog wheel, a jog switch, a finger mouse, or a wheel.

The input unit **120** may be configured with any of a touch sensor, a proximity sensor, an electromagnetic sensor, and a pressure sensor. The input unit **120** may detect a user's touch input or may detect a proximity input through the sensor. The input unit **120** may be configured with an input pad equipped with a sensor, illustratively provided in a film form

or in a panel form. For example, the input unit **120** may be configured with an electromagnetic sensor for performing EMR (Electro Magnetic Resonance) sensing, or an input pad for performing EMI (Electro Magnetic Interference) sensing.

The input unit **120** may be provided with an input screen by configuring a layered structure that performs the functions of a display unit **150**. For example, the input unit **120** may include an input pad having a touch sensor and a TSP (Touch Screen Panel) combined with the display unit **150**. The input unit **120** having a layered structure equipped with the display unit **150** is called a touch screen.

According to an exemplary embodiment of the present invention, the input unit **120** may receive a user's input for selecting a guide providing mode that provides guide information to the user. The input unit **120** may also receive a user's input for specifying one or more detailed items related to the guide providing mode. If more than one subject is included in an image collected by the camera unit **110**, the input unit **120** may receive a user's input for selecting a specific subject for which guide information is to be provided.

According to an exemplary embodiment of the present invention, the input unit **120** detects a user's input for setting a photographing mode of the camera unit **110**, or a user's input requesting that the camera take a photograph, or both.

The control unit **130** controls the general operation of the electronic device **100**. For example, the control unit **130** identifies a location of a light source that is illuminating a subject by analyzing the image collected by the camera unit **110**.

In order to perform the foregoing functions, the control unit **130** may include a face detector **131**, a photometer **132**, and a calculator **133**.

The face detector **131** detects a face of a human subject from the image collected by the camera unit **110** by using any of various face detecting algorithms. For example, the face detector **131** may detect the face area by using a knowledge-based algorithm for detecting a face according to a principle based on studying knowledge of features that are indicative of a face appearing in an image, or a bottom-up feature-based algorithm for detecting a face by using general characteristics that may appear in an image that includes a face, or a template matching algorithm for detecting an area having a higher similarity to standard pattern information in an image by using standard pattern information for a face image as calculated by a specific function, or an appearance-based algorithm for detecting a face area by using a statically analyzed result of the characteristics of face images. The step of detecting a face may be performed together with an automatic face recognition function of the camera unit **110**.

The algorithm for detecting a face may be performed by using a program code that is stored in a non-transitory computer readable medium such as the storage unit **140**. For example, the algorithm for detecting a face may be performed by using program code that includes an open source library (for example, OpenCV) for processing computer vision management. The face detector **131** detects a face from a collected image by executing a program stored in the storage unit **140**.

The photometer **132** measures the brightness of a specific area, namely the extent of an exposure, in one or more portions of an image collected by the camera unit **110**. The photometer **132** may measure the brightness of the specific area according to a matrix method, a partial method, or a spot metering method.

The photometer **132** may divide an image into a plurality of areas, and measure an exposure value for each area of the plurality of areas. The number, size, and shape of the divided areas may be decided according to the design of the camera unit **110**. The photometer **132** labels the exposure values of each area according to the result of the brightness measuring.

The control unit **130** identifies a location of a light source in the image based on the exposure value measured by the photometer **132**.

The calculator **133** calculates the direction of the light source relative to a subject based on the face area of the subject and the location of light source identified by the face detector **131** and the photometer **132**. The calculator **133** further calculates movement information for at least one of the subject and the light source based on a predetermined direction of the light source representing an optimized or preferred direction, and a calculated direction of the light source representing the actual current measured direction of the light source.

According to an exemplary embodiment of the present invention, the control unit **130** generates guide information for adjusting the direction of light source relative to the subject in the image collected by the camera unit **110** to correspond with the predetermined direction of light source. The control unit **130** controls the electronic device **100** to output the generated guide information.

In more detail, the control unit **130** measures the direction of the light source relative to the subject in the image, and generates movement information for at least one of the subject or the electronic device **100**. The movement information specifies a suggested or recommended movement of the light source, the electronic device **100**, or the subject that is required to achieve a desired direction or orientation of the light source relative to the subject. The desired direction or orientation is achieved when the measured actual current direction of the light source is identical to the predetermined direction of the light source. The control unit **130** generates the guide information based on the movement information, and controls the display unit **150** to output the guide information.

According to an exemplary embodiment of the present invention, the control unit **130** extracts a face area in an image through the face detector **131**, and identifies a location of a light source through the photometer **132**. The control unit **130** further identifies a direction of a light source to the extracted location of the face area through the calculator **133**, and calculates movement information for at least one of the face as a subject or the light source according to the predetermined location of the light source. The control unit **130** generates guide information based on the calculated movement information, and controls the electronic device **100** to output the guide information.

Hereinafter, the operation of the control unit **130** is described in more detail referring to the accompanying drawings.

The storage unit **140** stores a program or a command for the electronic device **100**. The control unit **130** may execute the programs or commands stored in the storage unit **140**.

The storage unit **140** may include at least one type of non-transitory storage media such as a flash memory, a hard disk, a micro-type multimedia card, a card memory (for example, SD or XD memory), a RAM (Random Access Memory), a SRAM (Static Random Access Memory), a ROM (Read-Only Memory), an EEPROM (Electrically Erasable Programmable Read-Only Memory), a PROM

(Programmable Read-Only Memory), a magnetic memory, a magnetic disk, and an optical disk.

According to an exemplary embodiment of the present invention, the storage unit **140** may store an image collected by the camera unit **110** temporarily or permanently. The storage unit **140** further stores temporarily or permanently a photo or moving image generated according to a request for taking a photograph that is accepted from a user. The storage unit **140** may store information related to the image such as the date and the time that the photograph was taken, the geographic location where the photograph was taken, status information indicative of one or more photographing modes or settings of the camera, and pixel information for the photograph, together with the actual photographic image.

The display unit **150** outputs information processed by the electronic device **100**. For example, the display unit **150** displays an application currently being executed and information corresponding to a program or a service. The display unit **150** may be equipped with one or more of a UI (User Interface) or a GUI (Graphical User Interface).

The display unit **150** may operate as a touch screen by configuring the input unit **120** and the sensor **130** in a layered structure. Here, the display unit **150** operating as a touch screen may perform the functions of the input unit **120**.

According to an exemplary embodiment of the present invention, the display unit **150** displays a preview image of a collected image under the control of the control unit **130**. The display unit **150** displays a user interface for a camera control together with the preview image. For example, the display unit **150** displays user interfaces for setting a photographing mode such as a shutter speed, an aperture opening, a white balance, an ISO, and a filter application, together with the preview image. Alternatively or additionally, the display unit **150** displays user interfaces for accepting a request for taking a photograph, switching between still photo mode and moving picture mode, and zooming in and out, together with displaying the preview image. The user interface may be configured with at least one of an icon, an image, and text.

Further, according to an exemplary embodiment of the present invention, the display unit **150** displays guide information under the control of the control unit **130**. The guide information may comprise information for adjusting a direction of light source relative to a subject in an image so as to be identical to a predetermined direction of the light source. The guide information may be provided using at least one of an icon, an image, or text. Here, the display unit **150** may display the guide information together with the preview image.

The communication unit **160** performs transmission and reception of wireless signals with an external device. The communication unit **160** may include at least one module or circuit enabling wireless communication between the electronic device **100** and a wireless communication system, or between the electronic device **100** and a mobile communication system at which the electronic device is located. For example, the communication unit **160** may include any of a mobile communication module **161**, a wireless internet module **162**, and a satellite communication module **163**.

The mobile communication module **161** may transmit a wireless signal to a base station or a server. The wireless signal may include a voice call signal, a video-telephony call signal, or various data including characters and multimedia message transmissions. The mobile communication module **161** may transmit a wireless signal to a base station by using a 3G or a 4G communication network, and may also use a

communication network of the next generation beyond 4G according to the development of technology.

The wireless internet module **162** is a module for connecting to a wireless internet communications link, and may be installed in the electronic device or externally. The wireless internet module **162** may exchange a wireless signal by using a communication technology such as a WLAN (Wireless LAN), Wi-Fi, Wibro (Wireless broadband), Wimax (World Interoperability for Microwave Access), and HSDPA (High Speed Downlink Packet Access).

The satellite communication module **163** transmits data by using a wireless signal received from a satellite. In an exemplary embodiment of the present invention, the satellite communication module **163** may include a GPS receiver for receiving a wireless signal from a GPS satellite. The GPS receiver identifies a location of the electronic device **100** by using a microcomputer and a wireless signal received from the satellite.

According to an exemplary embodiment of the present invention, the communication unit **160** may receive information related to a location or position of the sun and an altitude of the sun above the earth from a server when an image is collected by the camera unit **110**. The control unit **130** identifies the location of the light source in the image collected by the camera unit **110**, based on the location information of the sun received through the communication unit **160**.

The sensor **170** identifies the current or present state of the electronic device **100** by collecting information related to any change in magnetic field, gravity, pressure, temperature, or humidity. The sensor **170** may include a direction sensor **171** and a gyro sensor **172**.

The direction sensor **171** identifies a bearing or directional orientation of the electronic device **100** by detecting a terrestrial magnetism surrounding the electronic device **100**. The direction sensor **171** may be configured with a terrestrial sensor or a sensor operating similar to the terrestrial sensor.

The gyro sensor **172** is a sensor for measuring a rotation angle of the electronic device **100**, and may detect the rotation angle based on 3-dimensional axes. For example, the gyro sensor **172** may detect rotation angles to x, y, and z axes based on the electronic device **100** as a center point. Namely, the gyro sensor **172** may detect pitching, rolling, and yawing of the electronic device **100**.

According to an exemplary embodiment of the present invention, the control unit **130** identifies a direction at which the camera unit **110** is aiming, based on the information collected through the sensor **170**. The control unit **130** identifies the direction of subject to the electronic device **100** according to the direction in which the camera unit **110** is aiming.

The electronic device **100** may further include a sound generator for outputting a sound and a haptic generator for outputting a vibration.

All of the components illustrated in FIG. **1** may not be essential for implementing certain of the exemplary embodiments described previously. For example, some of the components shown in FIG. **1** may be omitted from the electronic device **100**. Moreover, additional components not shown in FIG. **1** may be added to the electronic device **100**.

FIG. **2** is a drawing showing an illustrative setting screen **10** that provides guide information to a camera according to an exemplary embodiment of the present invention. The setting screen **10** may include items such as a guide providing mode setting **11**, a light source direction setting **12**, and an automatic control setting for photographing mode **13**.

The guide providing mode setting **11** is provided to set whether the guide providing function according to various exemplary embodiments of the present invention is to be performed or not. The guide providing mode setting **11** receives an input for setting the guide providing mode to "on" or "off" according to a selection received from a user. If the guide providing mode is set to "on" through the guide providing mode setting **11**, the control unit **130** (FIG. **1**) generates and outputs guide information for an image collected by the camera unit **110**. If the guide providing mode is set to "off", the control unit **130** outputs only a preview image of an image collected by the camera unit **110** according to a general image processing method. According to an exemplary embodiment, the guide providing mode may be set to "on" or "off" through a quick menu, a shortcut key, or a shortcut button.

The light source direction setting **12** (FIG. **2**) is provided to set a direction of a light source relative to a subject in advance. In more detail, the light source direction setting **12** receives an input for setting whether or not to provide guide information in which a direction of the light source relative to the subject is projected in the image collected by the camera unit **110** (FIG. **1**).

Referring to FIG. **3**, the direction of the light source may include at least one of a front light **300a**, a plain light (**300b** or **300b'**), a side light (**300c** or **300c'**), a cross light (Rembrandt light; **300d** or **300d'**), or back light **300e** based on the center of a subject to be photographed by the electronic device **100** (FIGS. **1** and **3**).

With reference to FIG. **3**, the front light **300a** refers to a light source that is located substantially directly in front of a subject **200**, namely, in the same direction as the electronic device **100**. Using the front light **300a** to photograph the subject **200**, a bright image is produced without a shadow of the subject **200**, and thus the image is clean and detailed. However, in the case of photographing a portrait of a person, use of the front light **300a** may be problematic because some people will frown or squint their eyes in the presence of a bright light source.

The plain light (**300b** or **300b'**) refers to a light source that is located substantially at an approximate 45° direction to the right or left of the front side of the subject **200**. When illuminated by the plain light (**300b** or **300b'**), the subject **200** is generally photographed as a bright image with portions of the image being cast in a pale shadow, and thereby emphasizing the three-dimensional characteristics of the subject **200**.

The side light (**300c** or **300c'**) refers to a light source that is located substantially to the right or left to the subject **200**, namely, in a 90° direction to the right or left of the front side of the subject **200**. Using the side light (**300c** or **300c'**) to photograph the subject **200**, a strong shadow may appear at one side of the subject **200**, and thus a photographed image exhibits strong contrast between areas of light and areas of darkness.

The cross light (**300d** or **300d'**) refers to a light source that is located substantially at a 135° direction with reference to the front side of the subject **200**, or, in other words, at a 45° direction to the right or left of the rear side of the subject **200**. Using the cross light (**300d** or **300d'**) to photograph the subject **200**, the subject appears as a dark image due to being under-exposed. However, the cross light (**300d** or **300d'**) results in a somewhat dark and uniform illumination with small bright areas of highlights, but no unnecessary shadows, and thus a photographed image may provide a detailed, strong, and mysterious feeling.

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The back light **300e** refers to a light source that is located substantially at a 180° direction with respect to the front side of the subject **200**, namely, at the rear side of the subject **200**. Using the back light **300e** to photograph the subject **200**, a generally dark photo results due to underexposure. However, in some cases, strong outlines of the subject **200** are formed, and thus the photo provides a silhouette of the subject.

The possible directions or orientations of a light source to the subject **200** described previously are summarized in the following Table 1.

TABLE 1

Light source	Direction to subject	Characteristics of photo
Front light	Front side (0°, same direction as electronic device)	Bright, detailed, and clean
Plain light	Right/Left 45° from front side	3-dimensional effect and striking appearance
Side light	Right/Left 90° from front side	Strong image
Cross light	Right/Left 135° from front side (Right/Left 45° from rear side)	Mysterious image
Back light	180° from the front side (rear side)	Silhouette is emphasized

Several examples have been described above for illustrating various possible directions or orientations of the light source; however, the present invention is not limited to these enumerated examples and various directions or orientations of the light source in addition to those discussed previously may be considered with reference to the front side of a subject and according to an angle, distance, and height of the light source.

The light source direction setting **12** (FIG. 2) receives an input to set the direction of the light source desired by a user in advance. Illustratively, the direction of the light source may be selected from the directions of light source discussed previously and summarized in Table 1. If the user does not set the direction of the light source, the direction of light source may be set or selected automatically as a default value. Hereinafter, a case of setting the direction of the light source to the plain light **300b** is described, referring to FIG. 2.

The automatic control setting for photographing mode **13** receives a user's input for setting whether or not a guide information providing mode and a photographing mode are automatically provided. For example, the photographing mode may include one or more settings such as a shutter speed, an aperture opening, a white balance setting, an ISO setting, and a filter application setting. The automatic control setting for photographing mode **13** receives an input for setting an automatic control for the photographing mode to "on" or "off". If the automatic control for photographing mode is set to "on", the control unit **130** (FIG. 1) automatically sets at least one of the previously described photographing mode settings to an appropriate value according to the result of analyzing a collected image while photographing. The automatic control setting for photographing mode **13** (FIG. 2) may include a user interface for setting each photographing mode setting to a specific value in advance.

Several components of the setting screen **10** have been described as examples in FIG. 2, however the setting screen **10** according to an exemplary embodiment of the present invention is not limited to the examples described previously, and various setting screens may be configured according to any of various types of functions settable by a user, any of various methods of providing a user interface, and any of various methods of receiving a user's input for

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selecting photographing mode settings which are provided by the electronic device **100** (FIG. 1).

For example, the setting screen **10** (FIG. 2) may include a detailed image corresponding to the direction of light source as shown in FIG. 3. Alternatively or additionally, the setting screen **10** (FIG. 2) may include tutorial information to help the user select appropriate photographing mode settings. The setting screen **10** may further include a user interface for setting or selecting a method by which the guide information will be outputted or displayed, such as an image display, a sound output, or a vibration output.

Hereinafter, a detailed method of providing camera guide information is described based on the guide providing mode as set or selected as previously described.

FIG. 4 is a flow chart showing an illustrative method of providing guide information to or for a camera according to an exemplary embodiment of the present invention. In the method of FIG. 4, the case of photographing an image is described as an example; however, it is to be understood that the present invention is not limited to this particular example and may be applied to any of various exemplary embodiments requiring that guide information be provided to or for a camera, such as photographing a moving picture or engaging in a video telephony conversation.

Firstly, the control unit **130** (FIG. 1) drives or controls the camera unit **110** (FIG. 4, **1100**).

The control unit **130** (FIG. 1) drives or controls the camera unit **110** according to a user's request or a request by an application, a service, or a program. For example, the control unit **130** may drive or control the camera unit **110** according to a request by one or more applications, such as an application for a text message, a social networking service (SNS), a phone book, a video telephony conversation, or photographing.

The control unit **130** transmits a control signal to the camera controller **114** for driving or controlling the camera unit **110**. If the power of the camera unit **110** is switched off, the control unit **130** may control a power supply to supply an electric power to the camera unit **110**.

If a control signal is received from the control unit **130**, the camera controller **114** controls the operation of one or more components of the camera unit **110**.

Subsequently, the control unit **130** collects an image (FIG. 4, **1200**).

If the camera unit **110** (FIG. 1) is activated, the camera controller **114** collects lights reflected by the subject **200** (FIG. 3) through the lens **111** (FIG. 1). The collected lights are transmitted to the image sensor **112** and converted to electric signals, and the converted electric signals are converted to data signals by the image converter **113** so that the control unit **130** may process the data signals. The camera controller **114** receives the data signals converted by the image converter **113** and transmits the data signals to the control unit **130**. This procedure is repeated while the camera unit **110** is being controlled or driven by the control unit **130**.

The control unit **130** receives a data signal of the subject **200** (FIG. 3) from the camera controller **114** (FIG. 1). The control unit **130** processes the received data signal and generates image data so that the subject **200** (FIG. 3) may be visually output through the electronic device **100** (FIG. 1). The control unit **130** may store the generated image data in the storage unit **140** temporarily or permanently.

The control unit **130** collects an image of the subject **200** (FIG. 3) through the foregoing procedure. The control unit

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130 (FIG. 1) may collect the image of the subject 200 (FIG. 3) while the camera unit 110 (FIG. 1) is being driven or controlled.

Here, the image collected by the control unit 130 may include a plurality of subjects 200 (FIG. 3). Furthermore, the image collected by the control unit 130 (FIG. 1) may have a pattern changed to a specific brightness according to the relative locations of the subject 200, the electronic device 100, and the light source as shown in FIG. 3.

Referring to FIG. 5, the control unit 130 may collect an image of a person as the subject 200 (also see FIGS. 1 and 3). Here, the direction of the light source to the subject 200 (FIG. 3) as collected by the control unit 130 (FIG. 1) may be, for example, a right side light 300c (FIG. 3).

Together with an image, the control unit 130 (FIG. 1) may collect data regarding the image. For example, the control unit 130 may collect time information corresponding to a collected image, location information for the collected image, state information specifying one or more camera mode settings while collecting an image, and pixel information. The data regarding an image may be collected through at least one sensor installed in the electronic device 100.

Subsequently, the control unit 130 identifies whether the guide providing mode is active (1300, FIG. 4).

The control unit 130 (FIG. 1) may identify a setting state of the guide information providing mode. The guide information providing mode may be set by a user through the setting screen 10 shown in FIG. 2. Alternatively or additionally, the guide providing mode may be set to a default value as determined, for example, during the production of the electronic device 100 (FIG. 1). This default value may be, for example, an "on" state. The control unit 130 may be programmed to identify whether or not the guide information providing mode is active.

The control unit 130 may also identify detailed setting items for providing guide information. For example, if the guide information providing mode is active, the control unit 130 identifies a state of direction setting of the light source and a state of setting automatic control for photographing mode in order to provide the guide information.

If the detailed items for providing guide information are not set, the control unit 130 controls the display unit 150 to display the setting screen 10 (FIG. 2) for setting the detailed items. Furthermore, the control unit 130 (FIG. 1) performs a setting operation according to a user's input through the displayed setting screen 10 (FIG. 2). Alternatively, if the detailed items for providing guide information are not set, the control unit 130 may decide the detailed items according to default values set during the production of the electronic device 100 (FIG. 1).

Hereinafter, a method of providing guide information is described assuming that the direction of light source is preset to the right plain light 300b (FIG. 3) and the automatic control of photographing mode is set to be active.

If the guide information providing mode is set to be inactive, the control unit 130 displays a preview image according to a general method of processing a camera image (1400, FIG. 4).

The control unit 130 (FIG. 1) controls the display unit 150 to display a collected image as a preview image. The control unit 130 repeatedly collects the image, and controls the display unit 150 to display a preview image that changes in real time according to the movement of the subject 200 (FIG. 3) or the lens 111 (FIG. 1).

The control unit 130 controls the display unit 150 to display a user interface for controlling a camera together

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with the preview image. For example, the control unit 130 controls the display unit 150 to display a user interface for setting a photographing mode including one or more settings such as a shutter speed, an aperture opening, a white balance level, an ISO setting, or a filter application, together with the preview image. Alternatively or additionally, the control unit 130 controls the display unit 150 to display a user interface for requesting operations such as photographing, switching between still photo and moving picture, or zooming in and out. The user interface may be configured with at least one of an icon, an image, or text.

However, if the guide information providing mode is set to be active, the control unit 130 generates guide information for adjusting the location of the subject 200 (FIG. 3) relative to the location of the light source (FIG. 4, 1500). Hereinafter, a method of generating guide information according to an exemplary embodiment of the present invention is described in more detail.

Referring to FIG. 6, the control unit 130 identifies a location of the subject 200 (1510).

The control unit 130 (FIG. 1) extracts the subject 200 (FIG. 3) from the collected image and identifies the location of the subject 200 in the image.

The control unit 130 (FIG. 1) may extract the subject 200 (FIG. 3) by using any of various algorithms for extracting the subject 200. For example, the control unit 130 may use an algorithm extracting an outline of the subject 200 by using gradients of brightness, color, chroma, and the continuity of the gradient. Alternatively or additionally, the control unit 130 (FIG. 1) may use an algorithm extracting an area having a similar characteristic as the subject 200 (FIG. 3) by calculating similarities with respect to brightness, color, and chroma.

Referring to FIG. 7, in an exemplary embodiment of the present invention, the control unit 130 detects a face area 20 as a subject in the image by using a face detecting algorithm. The control unit 130 (FIG. 1) may detect a face area 20 (FIG. 7) by using any of various face detecting algorithms. For example, the control unit 130 (FIG. 1) may detect the face area by using a knowledge-based algorithm for detecting a face according to a principle based on studying knowledge, or a bottom-up feature-based algorithm for detecting a face by using a general characteristic that appears in a face image, or a template matching algorithm for detecting an area having a higher similarity to standard pattern information in an image by using the standard pattern information of a face image as calculated by a specific function, or an appearance-based algorithm for detecting a face area by using a statically analyzed result of the characteristics of face images. The algorithm for detecting a face may operate together with an automatic face recognition function of the camera.

The algorithm for detecting a face may be performed by using a program code stored in the storage unit 140. For example, the algorithm for detecting a face may be performed by using a program code including an open source library (for example, OpenCV) for processing computer vision management. The control unit 130 detects a face from the collected image by executing a program stored in the storage unit 140.

Several algorithms for extracting a subject 200 or a face area 20 as the subject 200 have been described previously as examples, but the algorithm for extracting a subject 200 (FIG. 3) by the control unit 130 (FIG. 1) is not so limited.

If a plurality of subjects 200 (FIG. 3) (including faces) are extracted, the control unit 130 (FIG. 1) may select a subject 200 to be used for identifying a location. Among the

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plurality of subjects **200** (FIG. 3), the control unit **130** (FIG. 1) may select a subject **200** (FIG. 3) located closest to the image as the subject **200** to be used for identifying a location. Alternatively, the control unit **130** (FIG. 1) may select a subject **200** (FIG. 3) according to a user's input. In detail, the control unit **130** (FIG. 1) controls the display unit **150** to display a preview image of the collected image. If the user's input is detected through the display unit **150** wherein this display unit is equipped with a touch screen, the control unit **130** selects a subject corresponding to the detected input as the subject **200** (FIG. 3) to be used for identifying a location. Alternatively, the control unit **130** (FIG. 1) may select a subject according to a focus setting state of the camera unit **110**. For example, if the focus is set to a specific location in an image of the camera unit **110**, the control unit **130** may select a subject located closest to the set location as the subject **200** (FIG. 3) to be used for identifying a location. Furthermore, the control unit **130** (FIG. 1) may select a subject using any of various methods according to a setting state of the electronic device **100** or a control operation performed by the user.

The control unit **130** identifies a location of the subject **200** (FIG. 3) extracted from the image. The control unit **130** (FIG. 1) selects coordinates from a 2-dimensional plane, and shows the location of the extracted subject **200** in the 2-dimensional coordinates. Further, the control unit **130** may show the location of the extracted subject **200** (FIG. 3) in a coordinate system that uses more than two dimensions.

The control unit **130** (FIG. 1) may perform preprocessing operations such as adjustment of brightness, noise reduction, and geometric correction of the collected image, in order to identify the location of the subject **200** correctly. The preprocessing operation may be performed through the camera unit **110**.

In the image of FIG. 5, the control unit **130** identifies that the subject **200** is located in the center of the image according to the foregoing procedure. Here, the control unit **130** (FIG. 1) identifies that a face is located in the center of the image.

Additionally, the control unit **130** may identify a distance between the electronic device **100** and the subject **200** (FIGS. 1 and 3). The control unit **130** (FIG. 1) identifies the distance to the subject **200** (FIG. 3) by measuring a time of which infrared ray or ultrasonic waves emitted by the electronic device **100** (FIGS. 1 and 3) returns after reflected by the subject **200**. To perform this measurement, the electronic device **100** may include an infrared or ultrasonic emitter. If the control unit **130** (FIG. 1) identifies a face as the subject through face recognition, the distance to the subject **200** (FIG. 3) can be identified based on the size of the subject and an area ratio of the subject to the entire image. Besides this approach, various technologies and algorithm calculations may be used for identifying the distance between the electronic device **100** and the subject **200** (FIG. 3).

Subsequently, the control unit **130** (FIG. 1) identifies a location of light source by performing light measurement (**1520**, FIG. 6).

The control unit **130** (FIG. 1) identifies the location of light source by performing light measurements of brightness in specific areas of the image (to determine an exposure level). Here, the control unit **130** divides a collected image into a plurality of areas and measures an exposure value for each area according to a matrix metering method.

In detail, referring to FIG. 8, the control unit **130** divides the collected image into a plurality of areas. The number, size, and shape of the areas may be decided using any of

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various approaches. The control unit **130** then measures an exposure value for each of the plurality of areas and labels the exposure value of each area. FIG. 8 shows an example of labeling the exposure value of each of the plurality of divided areas when the exposure value of the brightest area in the plurality of divided areas is set to 10 and the exposure value of the darkest area in the plurality of divided areas is set to 1. In this manner, each of the areas shown in FIG. 8 are labeled with a corresponding exposure value such as 3, 4, 5, 6, 7, 8, or 9.

The control unit **130** (FIG. 1) identifies the location of light source based on the measured exposure value for each of a plurality of areas of the image. Using these measured exposure values, the control unit **130** identifies the location of the light source in the image based on the brightness distribution of each of the areas of the image. For example, in FIG. 8, the exposure value increases in the right and upper areas and decreases in the left and lower areas. In FIG. 8, the measured exposure values do not exhibit extremely high values as would be the case if the light source were to be located at the rear side of the subject **200**. Rather, in FIG. 8, it may be observed that the brightness decreases from the right side to the left side of the image. In this case, the control unit **130** identifies that the light source is located towards the right and upper side of the image.

The control unit **130** (FIG. 1) uses a set of coordinates of a 2-dimensional plane to display the location of the extracted subject **200** (FIG. 3) in this 2-dimensional plane. Furthermore, the control unit **130** (FIG. 1) may show the location of the extracted subject **200** (FIG. 3) in a coordinate system that uses more than 2 dimensions.

In an exemplary embodiment of the present invention, the control unit **130** (FIG. 1) may measure the exposure value of each of a plurality of divided face areas **20** (FIGS. 7 and 9) by using a technique similar to a matrix or spot metering method. Namely, if the face area **20** is extracted in the procedure of extracting a subject **200** (FIG. 3), the control unit **130** (FIG. 1) measures an exposure value of the extracted face area **20** (FIGS. 7 and 9).

In detail, referring to FIG. 9, the extracted face area **20** is divided into a plurality of areas. The number, size, and shape of the divided areas may be decided using any of various approaches. The control unit **130** (FIG. 1) then measures an exposure value for each of the plurality of divided areas and labels the exposure value of each area. FIG. 9 shows an example of labeling the exposure value for each of a plurality of divided areas when the extracted face area **20** (FIG. 9) is divided into the plurality of areas as shown in FIG. 7, when the exposure value of the brightest area in the plurality of divided areas is set to 10, and the exposure value of the darkest area in the plurality of divided areas is set to 1.

The control unit **130** (FIG. 1) identifies the location of light source in the face area **20** (FIG. 9) based on the measured exposure value. According to the result of measuring the exposure value, the control unit **130** (FIG. 1) identifies the location of the light source illuminating the face area **20** (FIG. 9) based on the distribution of divided areas having a higher brightness. For example, in FIG. 8, the exposure value increases in the right and upper areas and decreases in the left and lower areas. In FIG. 9, the measured exposure value does not show an extremely high value as would be the case if the light source were to be located at the rear side of the subject **200**, but rather decreases from the right side to the left side of the image. In this case, the

control unit **130** (FIG. 1) identifies that the light source is located at the right and upper side of the face area **20** (FIG. 9).

In an exemplary embodiment of the present invention, in order to correctly identify the location of a light source that is illuminating a subject, the control unit **130** determines the location or orientation of the light source by using methods such as averaging, statistical analysis, and scoring, based on the location or orientation of the light source in the image and the location of light source in the face area **20**.

Further, in an exemplary embodiment of the present invention, the control unit **130** (FIG. 1) may identify the location or orientation of the light source relative to the subject **200** (FIG. 3) based on the direction of the sunlight. In detail, the control unit **130** (FIG. 1) may receive location information (longitude and latitude) of the electronic device **100** from a GPS satellite through the satellite communication module **163**. The control unit **130** may receive the receive direction or orientation information of the sun projecting to the electronic device **100** at the time of image collection through the storage unit **140** or the communication unit **160**. The direction or orientation information of the sun projecting to the electronic device **100** at the time of image collection may be stored in the storage unit **140**. Furthermore, the control unit **130** may identify or determine a direction in which the camera unit **110** is aiming, by using information collected by the sensor **170**. The control unit **130** identifies the location information of the sun based on the direction or orientation of sunlight and the aiming direction of the camera unit **110**, and identifies the direction or orientation as the location of the light source.

For example, if the location information of the electronic device **100** identified through the satellite communication module **163** is 37° North latitude and the time of collecting an image is 2:00 pm, the control unit **130** identifies that the sun is located in a southerly direction by using data stored in the storage unit **140** or data received through the communication unit **160**. Furthermore, if the camera unit **110** is determined to be aimed to the east based on information collected by the sensor **170**, the control unit **130** identifies that the light source is located to the right.

In the foregoing description, several methods for identifying a location of light source, including a method of identifying a location of light source illuminating the face area **20**, have been described; however, various methods of identifying the location of the light source may be used and these methods are intended to fall within the scope of the present invention.

In the image of FIG. 5, the control unit **130** identifies that the light source is located at the right and upper sides of the image.

Subsequently, the control unit **130** (FIG. 1) identifies a direction of the light source to the subject **200** (FIG. 6).

The control unit **130** (FIG. 1) identifies the direction of the light source to the subject **200** (FIG. 3) based on the identified locations of the subject **200** and the light source. The control unit **130** (FIG. 1) identifies in which direction or at what orientation the light source is situated based on the location of the subject **200** (FIG. 3), for example, up, down, right, or left to the subject, and at the front or rear of the subject **200**.

The control unit **130** (FIG. 1) may use the exposure value that was measured in the process of identifying or determining the actual direction of the light source to determine a correct, desired, or optimized direction for the light source. For example, in order to distinguish plain light (**300b** or

**300b'**) (FIG. 3) illumination from cross light (**300d** or **300d'**) illumination, the control unit **130** (FIG. 1) may identify whether an image is generally dark, or whether a line or region of light is formed in a specific area by using the measured exposure values. According to the measured exposure values, if the image is generally dark or if a line or region of light is formed in a specific area, the control unit **130** identifies the direction of light source as being cross light (**300d** or **300d'**) (FIG. 3) illumination.

In the image of FIG. 5, the control unit **130** identifies that the direction of light source is a right side light **300c** through the above procedure.

Subsequently, the control unit **130** (FIG. 1) calculates movement information of at least one of the subject **200** and the electronic device **100** (FIG. 6).

The control unit **130** (FIG. 1) calculates the movement information based on a predetermined direction for the light source and the identified direction of the light source. The predetermined direction of the light source may be set or specified by a user through the setting screen **20** (FIG. 2) or may be stored in the storage unit **140** (FIG. 1) as a default value set during the production of the electronic device **100**. The control unit **130** may calculate movement information of the subject **200** (FIG. 3) or of the electronic device **100** (FIG. 1), of which the identified actual direction of the light source becomes identical to the predetermined, desired, or optimized direction of the light source. Here, the movement direction may include a subject for the movement, a movement direction, a movement distance, a rotation direction, or a rotation angle. If the camera unit **110** is externally connected to the electronic device **100** by a wire or wirelessly, or if the lens **111** is movable or rotatable, the movement information may be used as data for the camera unit **110** or for the lens **111**.

In an exemplary embodiment of the present invention, the control unit **130** may identify the direction of light source to the subject **200** (FIG. 3) as a right side light **300c** as shown in the image of FIG. 5. Further, in an exemplary embodiment of the present invention, the control unit **130** (FIG. 1) may set the direction of light source to the plain light (**300b** or **300b'**) as shown in FIG. 2. Referring to FIG. 3, the plain light (**300b** or **300b'**) close to the right side light **300c** corresponds to a right plain light **300b**. In order to change the actual or current direction of the light source from the right side light **300c** to the predetermined, desired, or optimized right plain light **300b**, at least one of the subject **200** or the electronic device **100** (or both) must move.

To change the actual or current direction of the light source from the right side light **300c** to a predetermined, optimized, or desired right plain light **300b**, the subject **200** must move backwards as shown in FIG. 10, or the electronic device **100** must move rightwards as shown in FIG. 11.

Alternatively, to change the actual or current direction of the light source from the right side light **300c** to the predetermined, optimized, or desired right plain light **300b**, as shown in FIG. 12, the electronic device **100** must move -45° along the circumference having a radius corresponding to the distance between the electronic device **100** and the subject **200** based on using the subject **200** as a center point. If the distance between the electronic device **100** and the subject **200** is 1 meter, the distance that the electronic device **100** needs to move along the circumference is about 0.8 meters according to the following Formula 1:

$$l = r \times \theta$$

Formula 1

where,  $l$  is a movement distance of the electronic device **100**,  $r$  is a distance between the electronic device **100** and the

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subject **200**, and  $\Theta$  is an angle difference in radians between the current or actual direction of the light source and a predetermined, optimized, or desired direction of the light source.

The control unit **130** (FIG. 1) may calculate the movement information based on the difference between the identified actual current direction of the light source and the predetermined, optimized, or desired direction of the light source. Namely, in the image of FIG. 5, the control unit **130** may identify movement information of which the subject **200** (FIG. 3) must move backwards or the electronic device **100** must move rightwards. Alternatively, the control unit **130** (FIG. 1) may identify movement information for which the electronic device **100** must move by  $-45^\circ$  along the circumference having the subject **200** (FIG. 3) as a center point, or move 0.8 m in the counterclockwise direction.

According to another exemplary embodiment of the present invention, the movement information according to the identified actual current direction of the light source and the predetermined, optimized, or desired direction of the light source may be calculated in advance and stored in the storage unit **140**. Logically, the movement information according to the identified direction of the light source and the predetermined direction of the light source is generally identical, and thereby the calculation time may be reduced by storing the movement information according to the identified direction of the light source and the predetermined direction of the light source from the storage unit **140** and obtain the movement information according to the result of the search.

The control unit **130** may identify image information of the detected image, such as color information and contrast information, in addition to or in lieu of identifying the exposure value. The control unit **130** may select a photographing mode for obtaining an optimized photo based on the identified image information. If the automatic control of photographing mode is set to "on" through the setting screen **20** (FIG. 2), the control unit **130** (FIG. 1) may select the photographing mode based on the identified image information so that the identified image information corresponds to a predetermined image information. In detail, if the identified image information is not identical to the predetermined image information set by the manufacturer of the electronic device **100** or by a user, the control unit **130** selects the photographing mode so that the identified image information corresponds to the predetermined image information. The photographing mode may include any of a shutter speed, an aperture opening setting, a white balance setting, an ISO setting, and a filter application setting.

Lastly, the control unit **130** generates guide information based on the movement information (**1550**, FIG. 6).

The guide information provides a user with movement information so that the user may adjust the direction or orientation of the light source to the subject **200** (FIG. 3) according to the predetermined, optimized, or desired direction of the light source. The guide information includes at least one of an icon, an image, or text corresponding to the movement information. The guide information comprises movement information including any of the icon, the image, or the text, such that the movement information is indicative of a subject for the movement such as a subject **200** (FIG. 3) or an electronic device **100**, a movement direction, a movement distance, a rotation direction, and a rotation distance. The guide information may further include infor-

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mation related to any of voice conversion data, vibration period, intensity of vibration, brightness of light, color, blinking period, audio data for outputting a voice, vibration, or light.

If the control unit **130** (FIG. 1) completes selection of a photographing mode according to the setting of automatic control for photographing mode and the predetermined image information, the control unit **130** generates guide information including the selected photographing mode.

The control unit **130** may store the generated guide information in the storage unit **140** temporarily or permanently. The control unit **130** may store information for a collected image in the storage unit **140** by combining the collected image with the guide information. The control unit **130** may store information including any of a time at which a photograph was taken, a location at which the photograph was taken, information regarding one or more setting states or operational modes for the camera or pixel information. The pixel information may, but need not, be combined with the guide information.

If the generation of guide information has been completed, the control unit **130** outputs a preview image and guide information (**1600**, FIG. 4).

The control unit **130** (FIG. 1) controls the display unit **150** to display a preview image of the collected image. The control unit **130** may control the display unit **150** to display a user interface for setting a photographing mode including a shutter speed, an aperture opening, a white balance setting, an ISO setting, and a filter application setting, together with the preview image. Furthermore, the control unit **130** may control the display unit **150** to display a user interface for requesting that a photograph be taken, switching between still photo and moving picture, and zooming in and out, together with the preview image. The user interface includes at least one of an icon, an image, or text.

The control unit **130** may control the display unit **150** to display the generated guide information together with the preview image. The control unit **130** may control the display unit **150** to display the guide information in the preview image or in a separate area from the preview image.

In the exemplary embodiment of FIG. 5, the control unit **130** may control the display of guide information **30** by generating an instruction to move the subject backwards in the preview image according to the identified movement information as shown in FIG. 13. Alternatively, the control unit **130** may control the display of guide information **40** by generating an instruction to move the electronic device **100** rightwards according to the identified movement information as shown in FIG. 14. Furthermore, the control unit **130** may control the display of the identified movement information in the form of any of an image or icon, angle information, moving path, or movement distance in numerals.

In an exemplary embodiment of the present invention, the control unit **130** may output at least one of a voice, a vibration, or light. For example, the control unit **130** may output a text included in the guide information as a voice. Alternatively, the control unit **130** may output a vibration along the right, left, up, or down directions of the electronic device **100** according to movement information included in the guide information. The control unit **130** may further output a vibration or a light until the direction of the light source to the subject becomes to identical to the predetermined or optimized or desired direction by moving the subject **200** or the electronic device **100** according to the guide information.



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The control unit **130** repeatedly collects images through the camera unit **110**, identifies movement information for adjusting the direction of the light source, and displays guide information by updating the guide information in real time until the direction of the light source reaches the predetermined, optimized, or desired direction of the light source. Furthermore, the control unit **130** may repeatedly output a voice, a vibration, or a light until the actual current direction of the light source reaches the predetermined, optimized, or desired direction of the light source.

In the case that the photographing mode is selected according to the setting of automatic control for photographing mode, the control unit **130** may control the display of guide information including displaying the result of selecting the photographing mode. Alternatively, the control unit **130** may automatically set the photographing mode to a preselected photographing mode.

Subsequently, the control unit **130** identifies whether a request for photographing an image is generated (**1700**, FIG. 4).

The control unit **130** (FIG. 1) may identify whether a request for photographing is generated. The request for photographing may be generated through the input unit **120** or the display unit **150** including a touch screen. Alternatively, the request for photographing may be generated as a signal according to instructions issued by an application, a program, a service, or a signal transmitted from the outside through a communication unit installed in the electronic device **100**.

If the request for photographing is generated, the control unit **130** generates and stores a photo (**1800**, FIG. 4).

The control unit **130** (FIG. 1) generates the photo by processing the image collected at the time of photographing. The generated photo may, but need not, have a compressed format such as a jpg, jpeg, tif, or bmp. The control unit **130** may store the generated image in the storage unit **150** temporarily or permanently. The control unit **130** may store data including any of a file name, a file size, photo information, or photographer information by combining this data with the photo.

The control unit **130** may control the display unit **150** to display a stored photo. The control unit **130** may control the display unit **150** to display the stored photo for a predetermined time or until a user's input is detected.

The control unit **130** may play a designated sound or audio file while photographing, and controls the display unit **150** to display an icon, image, or text indicating that a photo is being generated.

If photographing is not requested, the control unit **130** returns to the step of collecting an image and repeats the guide information providing operation according to an exemplary embodiment of the present invention.

For the image collected in real time through the camera unit **110**, the control unit **130** repeatedly generates guide information and displays the guide information for the user.

The above-described embodiments of the present disclosure can be implemented in hardware, firmware or via the execution of software or computer code that can be stored in a recording medium such as a CD ROM, a Digital Versatile Disc (DVD), a magnetic tape, a RAM, a floppy disk, a hard disk, or a magneto-optical disk or computer code downloaded over a network originally stored on a remote recording medium or a non-transitory machine readable medium and to be stored on a local recording medium, so that the methods described herein can be rendered via such software that is stored on the recording medium using a general purpose computer, or a special processor or in program-

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mable or dedicated hardware, such as an ASIC or FPGA. As would be understood in the art, the computer, the processor, microprocessor controller or the programmable hardware include memory components, e.g., RAM, ROM, Flash, etc. that may store or receive software or computer code that when accessed and executed by the computer, processor or hardware implement the processing methods described herein. In addition, it would be recognized that when a general purpose computer accesses code for implementing the processing shown herein, the execution of the code transforms the general purpose computer into a special purpose computer for executing the processing shown herein. Any of the functions and steps provided in the Figures may be implemented in hardware, software or a combination of both and may be performed in whole or in part within the programmed instructions of a computer. No claim element herein is to be construed under the provisions of 35 U.S.C. **112**, sixth paragraph, unless the element is expressly recited using the phrase "means for".

Although exemplary embodiments of the present invention have been described in detail herein, it should be understood that many variations and modifications of the basic inventive concepts described herein will still fall within the scope of the present invention as defined in the appended claims.

What is claimed is:

1. A method of providing guide information for a camera, the method comprising:

collecting an image through the camera, wherein the image includes a subject illuminated by a light source; determining, by a controller, an optimized angle between a direction of a light source and the subject and a direction of the camera and the subject;

measuring, by the controller, an actual angle between the direction of the light source to the subject and the direction of the camera to the subject;

generating, by the controller, guide information that specifies an adjustment of the direction of the light source to the subject for achieving the optimized angle based on the difference between the optimized angle and the actual angle; and

displaying the generated guide information on a display.

2. The method of claim 1, wherein the generating guide information comprises:

calculating movement information for at least one of the subject or the camera based on the difference between the optimized angle and the actual angle, wherein the movement information has a distance.

3. The method of claim 2, wherein the measuring the actual angle comprises:

identifying a location of the subject in the image; identifying a location of the light source by performing light brightness measuring within the image; and identifying the direction of the light source to the subject based on the location of the subject and the location of the light source.

4. The method of claim 3, wherein the identifying a location of the subject comprises:

accepting a user's input for selecting the subject among a plurality of subjects in the image; and identifying a location in the image corresponding to the selected subject.

5. The method of claim 3, wherein the identifying the location of the subject comprises extracting a face area of the subject by using a face detection algorithm.

6. The method of claim 5, wherein the identifying a location of the light source comprises:

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- dividing the image into a plurality of areas;  
 measuring an exposure value for each of the plurality of areas;  
 dividing a face area of the image into a plurality of sub-areas of the face area;  
 measuring an exposure value for each of the plurality of sub-areas of the face area; and  
 identifying a location of the light source based on the exposure value for each of the plurality of areas of the image and the exposure value for each of the plurality of sub-areas of the face area.
7. The method of claim 3, wherein the identifying of the location of the light source comprises:  
 dividing the image into a plurality of areas;  
 measuring an exposure value for each of the plurality of areas; and  
 identifying a location of the light source based on the measured exposure value for each of the plurality of areas.
8. The method of claim 2, wherein displaying of guide information comprises displaying both a preview image of the image and the guide information.
9. The method of claim 1, wherein the generating of guide information comprises:  
 identifying an angle difference between the actual angle and the optimized angle;  
 determining a distance between the camera and the subject;  
 calculating a curved movement distance based on the angle difference and the distance between the camera and the subject according to the following Formula 1; and  
 generating the guide information by using at least one of:  
 (a) the identified angle difference, or (b) the curved movement distance;

$$l=r\times\theta$$

Formula 1

where,  $l$  is a curved movement distance,  $r$  is a distance between a camera and a subject, and  $\theta$  is an angle difference in radians.

10. The method of claim 1, wherein displaying of guide information comprises outputting at least one of a voice, a vibration, or light corresponding to the guide information.

11. The method of claim 1, wherein the direction of the light source to the subject is any one of front light, plain light, side light, cross light, or back light.

12. An electronic device, comprising:

a camera configured to collect an image of a subject illuminated by a light source;

a controller connected to the camera and configured to determine an optimized angle between a direction of a light source and the subject and a direction of the camera and the subject, measure an actual angle between the direction of the light source to the subject and the direction of the camera to the subject and generate guide information that specifies an adjustment of the direction of the light source to the subject for

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achieving the optimized angle based on the difference between the optimized angle and the actual angle; and  
 a display connected to the controller and configured to display the guide information generated by the controller.

13. The electronic device of claim 12, wherein the controller calculates movement information for at least one of the subject or the electronic device based on the difference between the optimized angle and the actual angle, wherein the movement information has a distance, and generates the guide information based on the movement information.

14. The electronic device of claim 13, wherein the controller identifies a location of the subject in the image, identifies a location of the light source by performing light brightness measuring within the image, and identifies the direction of the light source to the subject based on the location of the subject and the location of the light source.

15. The electronic device of claim 14, further comprising an input device that accepts a user input for selecting the subject among a plurality of subjects in the image, wherein the controller identifies a location in the image corresponding to the selected subject.

16. The electronic device of claim 14, wherein the controller extracts a face area of the subject by using a face detection algorithm.

17. The electronic device of claim 16, wherein the controller divides the image into a plurality of areas, measures an exposure value for each of the plurality of areas, divides a face area of the image into a plurality of sub-areas of the face area, measures an exposure value for each of the plurality of sub-areas of the face area, and identifies a location of the light source based on the exposure value for each of the plurality of areas of the image and the exposure value for each of the plurality of sub-areas of the face area.

18. The electronic device of claim 14, wherein the controller divides the image into a plurality of areas, measures an exposure value for each of the plurality of areas, and identifies a location of the light source based on the measured exposure value for each of the plurality of areas.

19. The electronic device of claim 13, wherein the display displays both a preview image of the image and the guide information under the control of the controller.

20. The electronic device of claim 12, wherein the direction of the light source is any one of front light, plain light, side light, cross light, or back light.

21. The electronic device of claim 12, wherein the controller receives a user input indicating optimized angle.

22. The electronic device of claim 12, wherein the electronic device further comprises:

a satellite communication module configured to receive location information of the electronic device;

wherein the light source is the sun; and

wherein the controller is configured to determine the actual angle by determining a direction of the sun to the subject based on the location information, and the time.

\* \* \* \* \*

UNITED STATES PATENT AND TRADEMARK OFFICE  
**CERTIFICATE OF CORRECTION**

PATENT NO. : 9,491,370 B2  
APPLICATION NO. : 14/242093  
DATED : November 8, 2016  
INVENTOR(S) : Jaeyung Yeo et al.

Page 1 of 1


It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

On the Title Page

Item (73), Line 2 should read as follows:

--...Yeongtong-gu, Suwon-si, Gyeonggi-do...--

Signed and Sealed this  
Fourteenth Day of February, 2017

A handwritten signature in black ink, reading "Michelle K. Lee". The signature is fluid and cursive, with the first letters of each name being capitalized and prominent.

Michelle K. Lee  
*Director of the United States Patent and Trademark Office*